AUTOMATIC SEGMENTATION OF RIVERS AS A TOOL FOR ASSESSING RIVER RESPONSES.

CASE STUDY: THE PORMA AND CURUEÑO RIVERS, NW SPAIN.

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Introduction

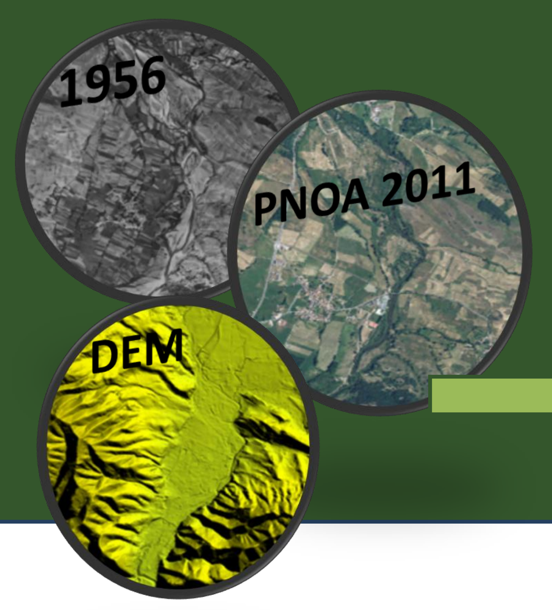
Automatic segmentation using **univariate and multivariate techniques** provides more objective and efficient segmentations of the river systems (Alber & Piégay, 2011) and can be complementary to the expert criteria traditionally used (Brenden *et al*., 2008)

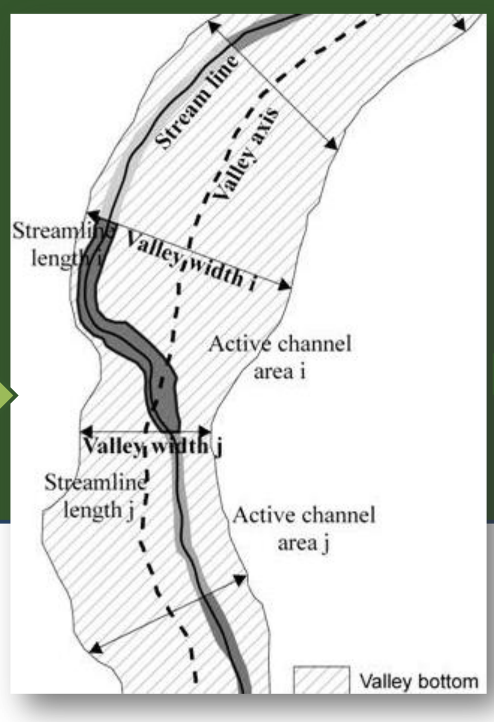
INTEREST: A powerful tool to objectively segment the continuity of rivers, which is required for diagnosing problems associated to human impacts

OBJECTIVE: **To evaluate the potentiality of univariate and multivariate methods in the assessment of river adjustments produced by flow regulation**

Methodology

1. Variables measurement with GIS





Longitudinal Data base of:
- Valley width
- Active channel width (1956)
- Active channel width (2011)

2.Segmentation procedure using Multi-Response Permutation Procedure

Identification of boundaries by applying statistical algorithms based on distances (MRPP, Orlowski et al. 1993)

Reaches delineation

Case study

Results

Univariate application to active channel from 1956 and 2011

- In 1956, 13 and 20 reaches are detected in Curueño and Porma R. resp., while 10 and 9 reaches are detected in 2011. The number of reaches decreases in both rivers, but more intensevely in the Porma River immediately downstream from the dam (Fig. 1 & 2)
- Channel narrowing is observed in both rivers, although intra-reach widths variation increases in the case of the lower Porma (downstream the confluence)

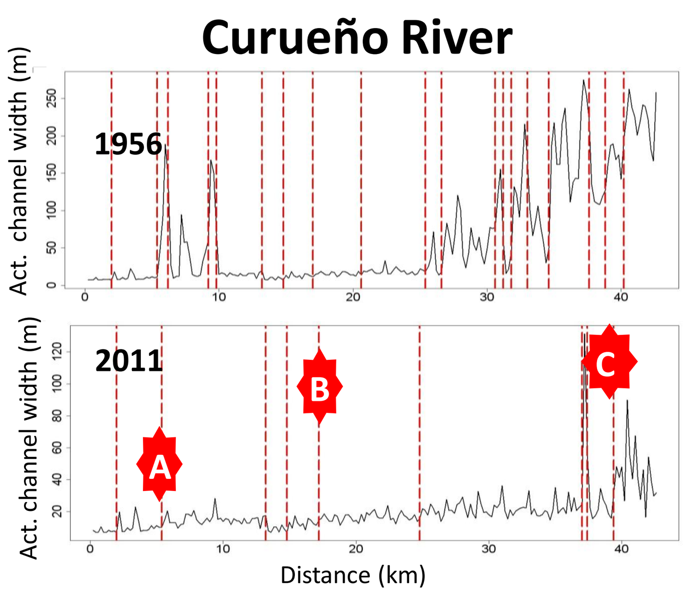
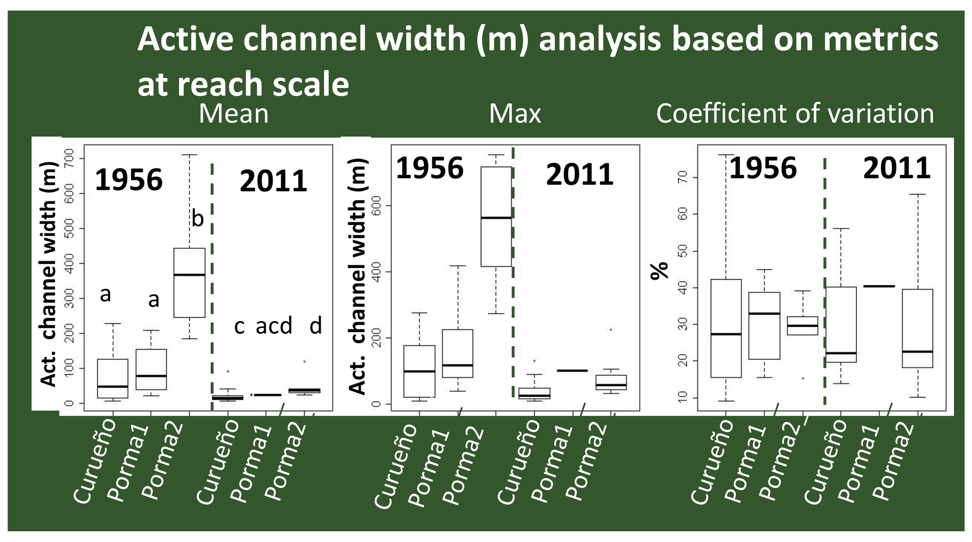


Figure 1. Curueño River segmentation results .Red vertical lines symbolize the boundaries of reaches. Red labels corresponds to sites zoomed in the map.



*Note: Porma 1 (between the dam and the Curueño confluence) and Porma 2 (dowstream the confluence). Different letters in left diagram means significant differences (p<0.05, Wilcoxon test) for mean active channel widths.

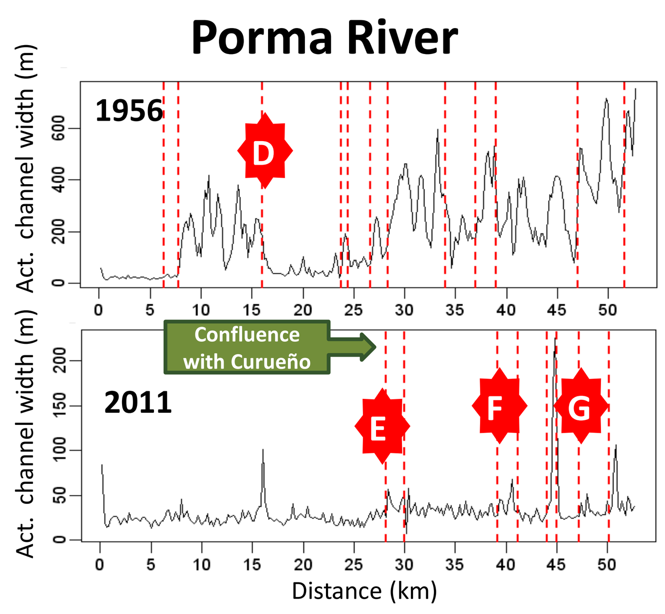
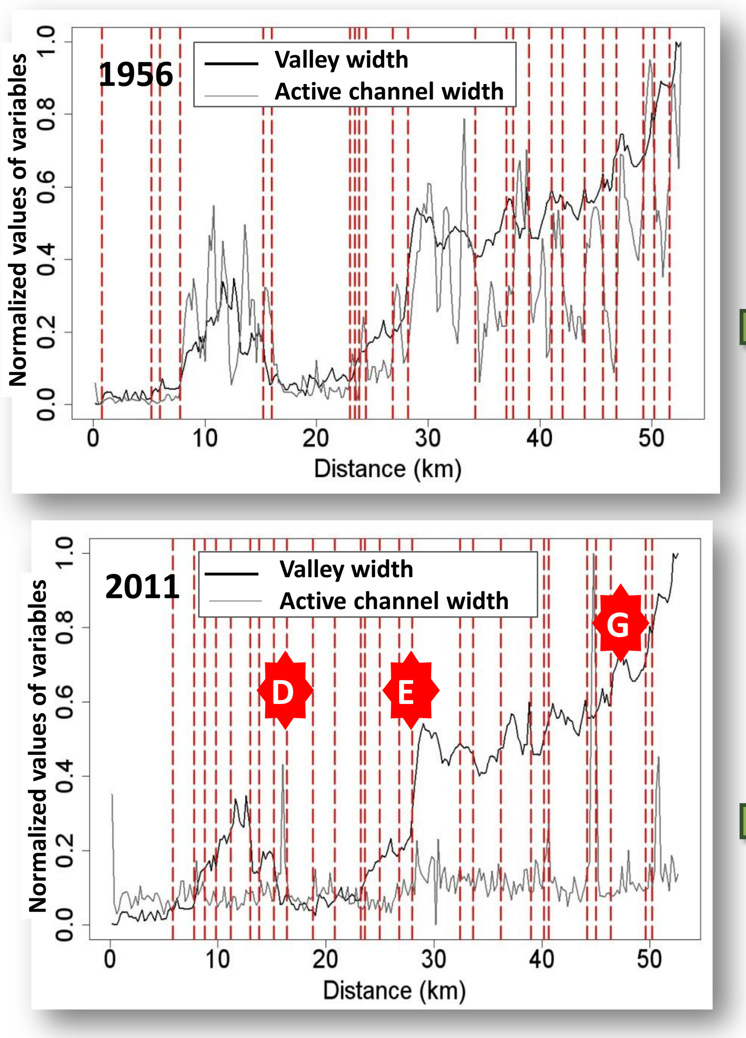
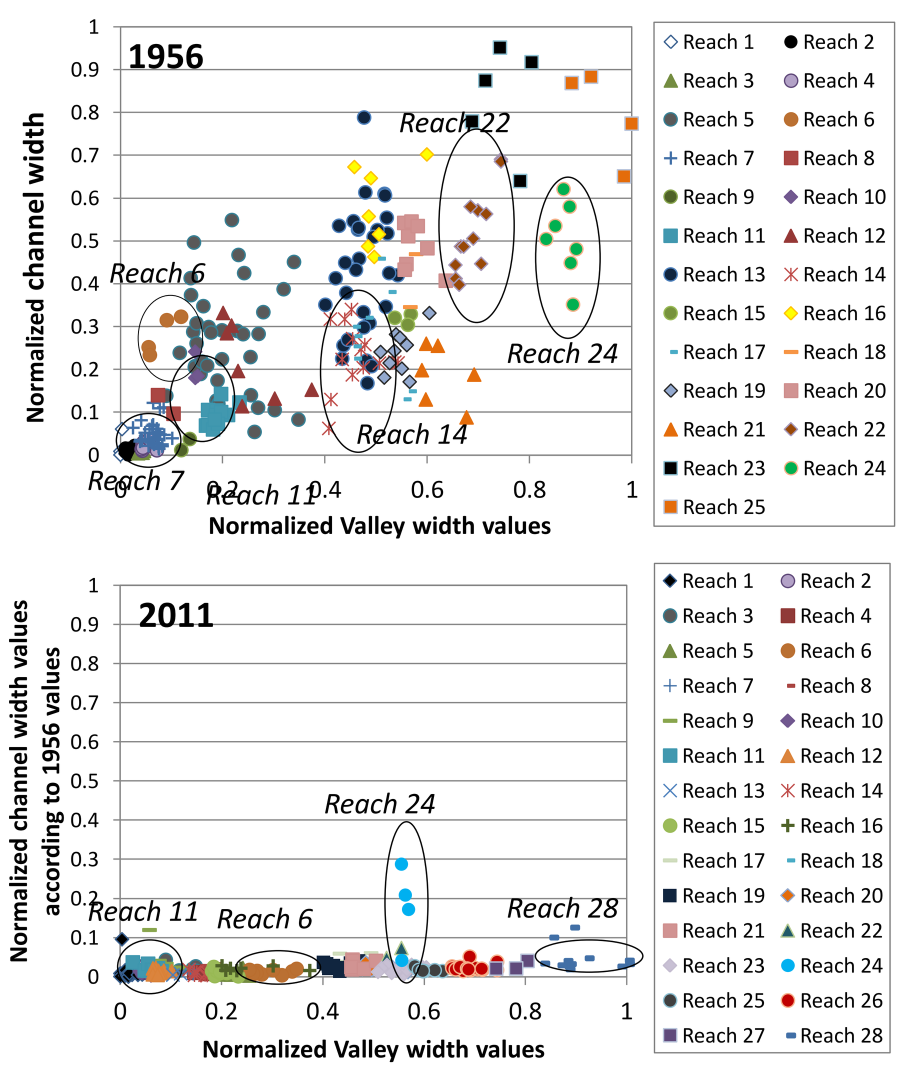


Figure 2. Porma River segmentation results. Red vertical lines symbolize the boundaries of reaches. Red labels corresponds to sites zoomed in the map.

Multivariate applications to valley and active channel width from 1956 and 2011 in Porma R.





- Similar number of segments in 1956 and 2011 (26 vs. 28 resp.) The range of variation of active channel width has declined
- Before the dam (1956) channel width was closely related to valley width (R=0.85). After the dam (2011), channel narrowing and homogenization occurred and the correlation of this variables significantly decreased (R=0.37)

Figure 3. Porma River segmentation based on valley and channel width in 1956 (top) and 2011 (bottom). Red vertical lines symbolize the boundaries of reaches. Red labels corresponds to sites zoomed in the map.

Figure 4. Scatter plot representing valley and channel widths in each reach (different colors) for those detected in 1956 (top) and 2011 (bottom).

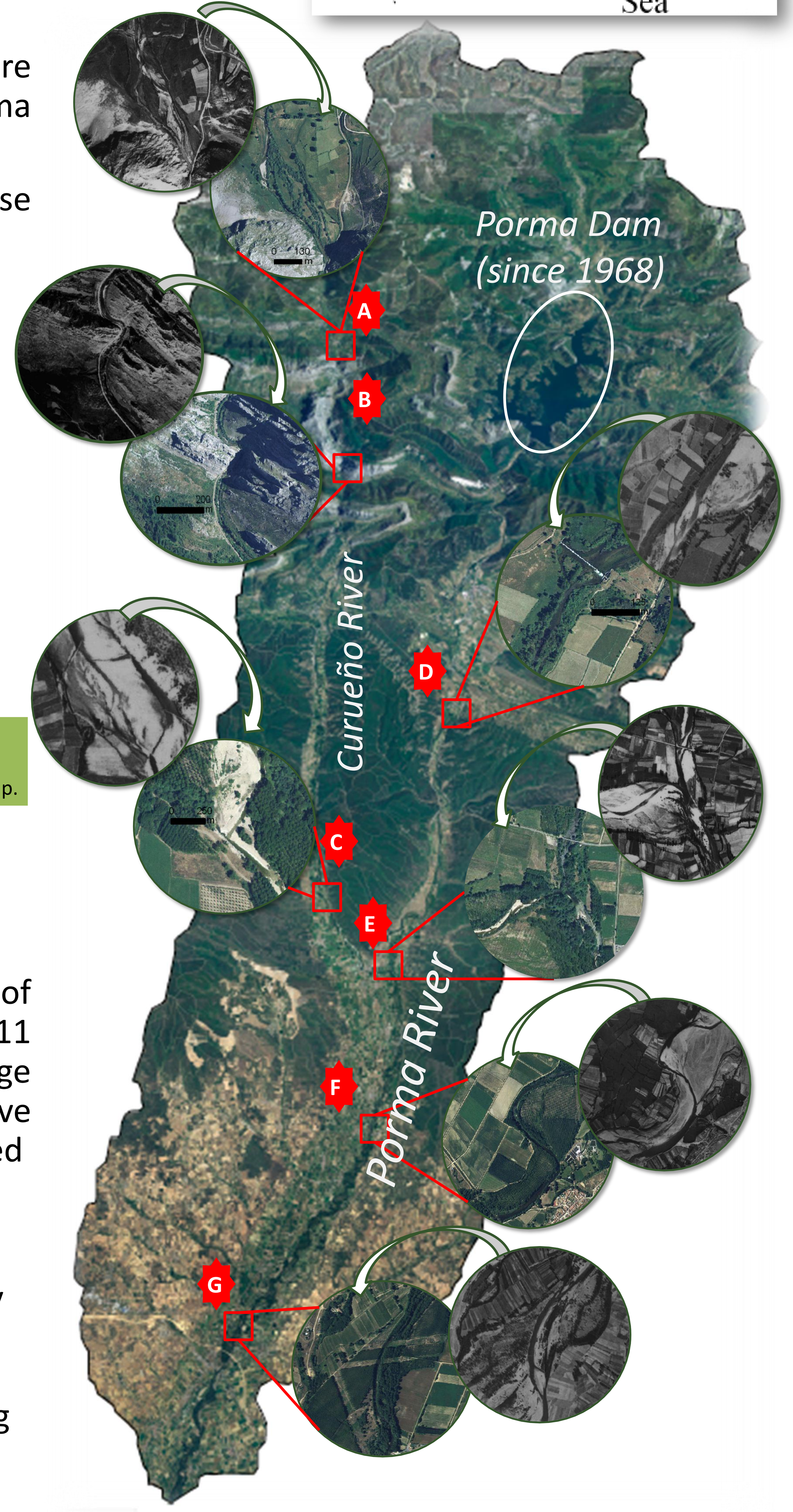


Figure 5. Location and appearance of some sites of Porma and Curueño River. Red labels correspond to those sites highlighted in Figures 1-3)

Conclusions

- These methods have resulted very useful in assessing river responses to human interventions (i.e. flow regime by damming) showing homogenization of the channel (decrease of the number of segments) below the dam.
- The univariate segmentation based on active channel width clearly reflects the effect of the dam and the effect of the confluence of the Curueño R. that partially mitigate the flow regulation effect downstream.
- The multivariate segmentation, although it can be useful in certain approaches, can hide the effect of human interventions on certain variables (active channel width) when they are mixed with invariant variables (e.g. valley width)

Acknowledgements

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References
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